

## INFRASTRUCTURE AND ECONOMIC GROWTH

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### ABSTRACT

The article sheds light on the theoretical base of infrastructure, how it has developed to be one of the important research fields. Nevertheless, the tangled manifold influence of infrastructure on the economy needs to be specified. The main questions that the article addresses are: What is infrastructure? How it impacts the economy? Is there confident empirical evidence on this impact?

**KEYWORDS:** Infrastructure, Social Overhead Capital, Social Infrastructure, Productivity, Production Process, Industrial Infrastructure

### INTRODUCTION

Although the scientific researches on economic growth and factors that provide economic growth are carried out systematically much earlier, attention is paid late to impact of infrastructure on economic growth. Nevertheless, the researches dedicated to these problems quickly become a separate independent field. Of course there is no doubt of importance of infrastructure in economic growth, a lot of works are dedicated to this problem, but only few of them tried to develop its theoretical background.

### WHAT IS INFRASTRUCTURE?

In our modern world the terminology “infrastructure” was widely used only in second half of the XX century, but A Smith have already wrote in his “wealth of nations...” about the necessity of public establishments and buildings needed for social productions processes, but unprofitable for private capital.

The word “infrastructure” came from Latin words “infra” – under and “struktura” – structure, system (which might mean understructure or background). At the beginning of XX century the word “infrastructure” is used to mean a system of establishments behind the frontline of the war, which provided the movement of the armies (materials, ammunition depots, military bases, polygons, divisions which get rid of obstacles and build bridges during movements of the main army). After 1940s this terminology is used in western economic and later in other literatures and meant those spheres of economy which help industry and agriculture [10].

In Marxist literature the terminology “infrastructure” is not used but there are concepts very close to this terminology. He used “general conditions of labor”, “material facilities needed for realizing labor process”, “general conditions of production”. He wrote that in a wider sense besides those things through which the labor could directly exert on the objects of production, the means of labor include all material terms (conditions), needed for the process to take place. These are not directly used in the production process but without them the process cannot take place or can take place in an inefficient way. In this sense Marxists include under the term infrastructure all the conditions needed for the production process to take place.

In the modern economic literature the foremost reference to the concept of infrastructure was given by A. O. Hirschman (1958). He differentiated between Direct Productive Activities (DPA) and Social Overhead Capital (SOC). The SOC can be seen as infrastructure and is usually defined as “those basic services without which primary, secondary and tertiary productive activates cannot function”.

According to Hirschman an activity can be included in the category of social overhead capital (Infrastructure) provided it satisfies the following conditions:

The services provided by the activity facilitate or are in some sense basic to the carrying on of a great variety of economic activities.

These services are usually provided in practically all countries by public agencies because of externalities, or by private agencies subject to some public control. They are provided free of charges or at rates regulated by public agencies.

These services cannot be imported.

These investments needed to provide the services are characterized by lumpiness (technical indivisibilities) as well as by a high degree of capital- output ratio (provided the output is at all measurable).

Nurkse(1955)elaborated the concept of overhead capital. According to him “overhead investment aims at providing the services – transport, power, and water supply, which are basic for any productive activity, cannot be imported from abroad, required large and costly installations and in the history of western economics outside England, have usually called for public assistance or public enterprise. Typically overhead investments take a considerable time to reach maturity in growing.

W. W. Rostow (1960) in his 'Theory of Stages of Growth' SOC is a pre-condition for take-off into self-sustained growth. Investment in SOC and development of those services encourages potential entrepreneurs to invest in risk-bearing business. Those SOC prepare the base for expansion of economic activities by decreasing the cost and increasing the profitability of productive activities. It also helps in the creation of an educated labour force, superstructures of communication networks, and mechanism to provide energy, basic civic amenities and law and order.

According to Rosenstein Rodan(1943)the services of overhead capital are indirectly productive and become available only after a long gestation period. They include all those basic industries like power, transport or communication. Their investments precede directly productive investments. They constitute the framework and overhead costs of the economy as a whole. Its installations are characterized by a sizeable initial lump and low variable cost.

Hansen (1965), in looking at the role of public investment in economic development, divides public infrastructure into two categories Economic Overhead Capital (EOC) and Social Overhead Capital (SOC). EOC is oriented primarily toward the direct support of productive activities or toward the movement of economic goods and includes most of the public works projects listed above. SOC is designed to enhance human capital and consists of social services such as education, public health facilities, fire and police protection, and homes for the aged.

That the infrastructure investment is called social overhead capital is not surprising because two of the main characteristics of it, huge amount of sum and long pay-back period, make it unattractive for private capital. In the framework of market economy these investments need an attention of government. These investments usually cannot be realized without government which uses tax collections to finance these projects. These investments are the preconditions

for the productive activities of private capital. It seems that in general infrastructure is part of the investments in the economy, but there are some characteristics that distinguish it from other investment projects. The main characteristics are given in the SOC concept of Hirschman above. It is thought that one of the important characteristics of infrastructure that results from all other characteristics is its impossibility to be wholly financed by private capital but needed for the functioning of it.

Infrastructure in a wider sense can be defined as any condition or auxiliary function necessary for the realization of the main purpose – the production process or human wellbeing. Its purpose is to create conditions for the functioning of production process as well as for living of humans. In this sense the infrastructure might include any conditions needed for the production process financed by private and public capital. But the part of infrastructure which is able to attract private capital is not the object of research. The researched part is the infrastructure financed mainly by public capital. So the narrow definition of the infrastructure can be stated as the stock of basic facilities and capital equipment needed for the functioning of production process or human which are impossible to finance solely by private capital. In this sense the term refers to roads, bridges, rail lines, energy supply chains and similar public works that are required for an industrial economy, or a portion of it, to function.

In general the infrastructure is divided into two main categories social and industrial infrastructure. Industrial infrastructure creates conditions for the production process, while social infrastructure serves for the human's general well-being.

Historically infrastructure facilities are established as a result of development of production process by division of main and auxiliary functions. The reason of this division was of course the division of labor and specialization of the production process. In this sense infrastructure can be seen as any activity which fulfills secondary functions.

## HOW INFRASTRUCTURE AFFECTS THE ECONOMY?

The linkage between infrastructure and economic growth is multiple and complex, because not only does it affect production and consumption directly, but it also creates many direct and indirect externalities, and involves large flows of expenditure thereby creating additional employment.

First of all, the infrastructure development creates conditions needed for the uninterrupted functioning of the production process. Some economists recommend to compare result of investments directed at infrastructure development not by increase of production, rather by decrease of possible losses that can be prevented by that investments;

Secondly, it reduces the cost of intermediate goods and transaction costs, which increasing the compatibility of national goods facilitates trade flows within and across borders;

Thirdly, the development of social infrastructure, provision of population by water, gas, electricity and other social facilities will at the end raise the population well-being;

Fourthly, infrastructure sectors are usually labor intensive which developed in the right way can be a factor in decreasing unemployment.

Besides there are other channels through which the infrastructure can affect the economy. These include encouragement of FDI in underdeveloped countries, increasing the capacity of the economy, enhancing human capital and others. The more the branches of production infrastructure is developed the more trustily will enter not only national but

international investments. The reason why the investors pay attention to this issue is explained by spending their investment in main production rather than into creating conditions for them. The increase of investment volume pushes the labor and employment rates upward, as well as stimulates the penetration of the results of scientific and thechnologic progress into the production process. This in turn, results in growth of population income and living standards, improvement of social life of the country through increase of general well-being. The effect of infrastructure investment can be divided into direct and indirect effects. It can directly effect on the demand side of the economy as any other investment expenses. Since very often it is huge projects whose effect will be significant for the economy.

Indirectly it can affect through other factors of production by creating conditions for cost reduction or increase of productivity of other inputs.

## EMPIRICAL EVIDENCE

Although the impact of infrastructure is more on productivity of inputs used in production process, a lot of work is dedicated to assessment of direct impact of infrastructure on growth parameters.

Since Ashauer (1989) a number of studies were conducted by the different economists in different time periods. To date, the macroeconomic studies focusing on public infrastructures contribution to productivity have offered wide-ranging conclusions. Based on which study one selects, infrastructure either contributes virtually nothing to productivity or produces a rate of return that is significantly above the rate of return for private capital. Such a range of estimates does little to help policymakers determine how to spend limited public resources. Debate over capital stock measures, the time period of the study, functional form, controls and geographic level of agglomeration have led to widely differing assessments of the value of infrastructure in various macroeconomic studies

Authors (e.g. Easterly and Rebelo 1993, Canning and Fay, 1993, Canning, 1999) using cross section-time series pooled data found that public infrastructure has positive effects on a country's productivity performance as well as growth is affected positively by the stock of infrastructure. In a large exercise, 102 cross country studies were assessed by Fuente and Estache (2004). Table 1 shows the distribution of the study findings. Studies conducted over the past 15years, few years find that infrastructure investment has a negative effect on productivity or growth.

**Table 1: Findings on Impact of Infrastructure Investment on Productivity and Growth [7]**

Area Studied	No. of Studies	Percentage Shown a Positive Effect	Percentage Shown no Significant Effect	Percentage Showing a Negative Effect
Multiple countries	30	40	50	10
United states	41	41	54	5
Spain	19	74	26	0
Developing Countries	12	100	0	0
Total/Average	102	53	42	5

*Source: de la Fuente and Estache (2004)*

The sample includes 30 studies of multiple countries (including developing countries), 41 studies on the United States, and 19 on Spain, 12 on individual developing countries (Argentina, Brazil, Colombia, India, and the Philippines). The study found that in a majority of these country studies, the impact of infrastructure on both growth and poverty reduction was positive, while in the case of 12 developing country studies this linkage was a hundred per cent. The role of investment in infrastructure in developing countries shows that these countries have underinvested in infrastructure, and

further that any investment here has the most significant impact on pro poor growth and direct impact on reducing poverty, apart from providing the poor with critical services. Another important study conducted by the World Bank Economist Stephane Straub (2008) a sample of 80 different specifications from the existing 30 macro-level empirical literature on the link between infrastructure and development outcomes in a critical light. These macro level studies, realized between 1989 and 2006, include some measure of infrastructure as an independent variable and some measure of economic performance (output level or growth, productivity level or growth) as dependent variable. Overall a little over half of them (45, equivalent to 56%) find a positive and significant effect of infrastructure, while 30 (38%) find no effect and 5 (6%) find a negative and significant effect. The major findings of the study, a number of stylized facts emerge from this initial view of the data. Overall, positive effects of infrastructure are found more often in the sample of developed countries, and when the dependent variable is output level rather than output growth or productivity. As for the independent variable, more conclusive results are obtained by studies using physical indicators rather than measures of public capital. Within these categories, looking at the specific sectors for which more than a few studies are included, positive effects are found mostly for telecom, roads and electricity in that order. Finally, studies based on a production function framework reach more positive conclusion than those relying on cross-country regressions.

**Table 2: Estimates of Output Elasticity of Infrastructure Indicators**

Country /Region	Author	Output Elasticity of Infrastructure	Infrastructure Measure
USA	Aschauer (1989)	0.39	Public capital
USA	Munnel (1990)	0.34	Public capital
Mexico	Shah (1992)	0.05	Transport, power&communication
Taiwan	UchimuraandGao (1993)	0.24	Transport, Water&communication
Korea	UchimuraandGao (1993)	0.19	Transport, Water&communication
DCs	EasterlyandRabelo (1993)	0.16	Transport&Communication
USA	GraciaMilaetal.(1996)	0	Public capital
LDCs	Devarajanetal. (1996)	Negative	Transport&Communication
Canada	Wylie (1996)	0.31	Public capital
Cross-Country	Canning (1999)	-0.23 to 0.22	Road, TelephoneandElectricity
USA	Duggalletal (1999)	0.27	Public capital
Cross- Country	Calderon&Serven(2003)	0.16	Transport&Communication
Cross –Country	EsfahaniandRamers (2003)	0.12	PowerandTelephones
OECD Countries	Kamps (2004a)	0.22	Public capital
SouthAfrica	Fedderke, Perkins, Luiz(2006)	-0.66 to 0.20	Physical capital stock
India	SahooandDash (2009)	0.4 to 0.5	Physical capital stock
SouthAsia	SahooandDash (2010)	0.26 to 0.3	Physical capital stock
China	Sahoo, Dash, Natraj(2010)	0.27 to 0.35	Physical capital stock

*Source: Sahoo, Pravakar (2011)*

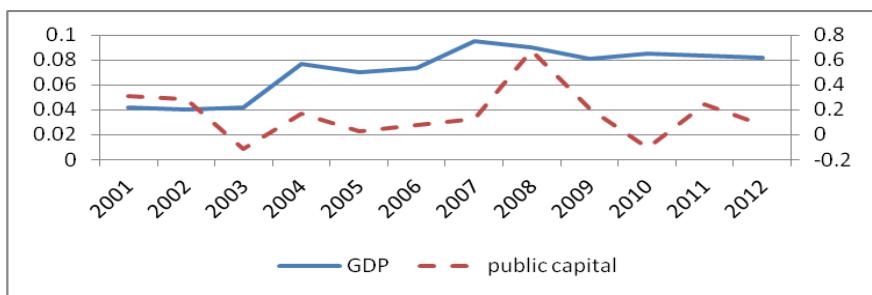
In general the studies that examine the relationship between public capital and economic growth suggest that although not all studies find a growth-enhancing effect of public capital, there are more consensuses in the recent literature

than in the older literature. According to most studies, the impact is much lower than found by Aschauer (1989), which is generally considered to be the starting point of this line of research. Many studies report that there is heterogeneity: the effect of public investment differs across countries, regions, and sectors. This is perhaps not a surprising result. After all, the effects of new investment spending will depend on the quantity and quality of the capital stock in place. In general, the larger the stock and the better its quality, the lower will be the impact of additions to this stock.

## EVIDENCE FROM UZBEKISTAN

Yet there are very few investigations in Uzbekistan on the infrastructure impact on growth parameters and no empirical evidence on this linkage. M. Ravshanov(2009) researched the influence of development of automobile road complex on economic growth in Uzbekistan. While K. Uljaboyev (1999) approached from regional point of view and assessed transport sufficiency of the regions of Uzbekistan, M. Oripov (2011) has revealed the influence of agriculture production infrastructure on developing agricultural sectors.

As a result of wide range economic reforms and despite the problems born due to international financial-economic crisis high rates of economic growth are maintained in Uzbekistan (figure 1). The economic growth of GDP has reached 8.1% in 2013.



**Figure 2: The Growth Rates of GDP and Public Capital in Uzbekistan, in Percentage<sup>1</sup>**

As we see from the figure the GDP and public capital parameters do not correlate with each other. Yet direct investment factors play more important role in the Uzbekistan's economy rather than indirect effects. Another explanation of such unusual correlation is that while Uzbekistan still has been privatizing its economic sectors there is less need for government finance of public sectors because those sectors will be invested by the private capital. Nevertheless, the share of public capital investments made up 6% and 5.1% of total investments, 1.37% and 1.2% of GDP in years 2011 and 2012 respectively which is significantly less than it is in other developing countries. In the 8.1% growth rate of Uzbekistan in 2013 the biggest share of 1.3% belongs to transport and communications sector, which is the main component of industrial infrastructure (1/6 share of GDP growth rate). It is no doubt that the expansion and development of production infrastructure also has influence on other fields with significant shares in economic growth rates like industry (1.1 percent), agriculture (1.1 percent), and construction (0.7 percent). It is clear that Uzbekistan should increase investments in infrastructure sectors to the levels of developing countries for further development of the economy in the next 10 years.

Yet this is not an exhaustive in depth analysis of the need for infrastructure in Uzbekistan. The linkage between growth parameters and infrastructure should be the object of many theoretic and empiric researches in Uzbekistan to understand this linkage more precisely.

<sup>1</sup>Based on information of State Statistics Committee of the Republic of Uzbekistan.

## CONCLUSIONS

In concluding, it should be mentioned that in addition to providing an immediate demand-side economic stimulus, public infrastructure investment has a significant, positive effect on long term output and growth. This long term output and growth elasticity of infrastructure is important. This impact comes through inputs' productivity and cost reduction which not always means increase of GDP. Productivity through decrease of costs might imply increase of production and hence the GDP, at the same time it decreases prices if the competition is in place which means decrease of GDP. Both cases positively impact the human wellbeing but not the GDP. As it implies many of the benefits of public investment are difficult to measure, and are not always included in the calculation of Gross Value Added.

The attempts of explaining impact of existing differences in capital stocks on the economy is only in their infancy. Only a few of the enormous bulk of studies on the output effects of infrastructure base their estimates on solid theoretical models. But to understand the problems arising from the empirical estimates, we must understand the channels through which infrastructure affects economic growth.

It should also be stressed that in a policymaking context aggregate results cannot be used to guide actual investment spending. Only cost-benefit studies can determine individual project's contribution and whether it should be implemented.

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